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Eutrophication, Nutrient Fluxes and Connectivity between the Bays of Great Salt Lake, Utah (USA)

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Natural geography and causeways have divided Great Salt Lake into four bays interconnected by breaches (Figure 1). Farmington Bay (~250 km^2) receives excessive wastewater discharges from nearby metropolitan Salt Lake City, and is hypereutrophic with massive blooms of toxic cyanobacteria when salinities are < 5%. The mean summer chlorophyll concentration in 2005–2006 was 186 µg/l, and concentrations of toxic nodularin reached 205 µg/l, exceeding the World Health Organization's human health guideline 10-fold. The entire water column in the bay is usually anoxic at night, hydrogen sulfide is abundant, and odors can be extreme. Brine shrimp production in this bay is minimal because of poor water quality and/or predation by air-breathing invertebrates (corixids).

We assessed how the massive production in Farmington Bay might impact nutrient loading and brine shrimp production in Gilbert Bay. Loading of the limiting nutrient (N) to Gilbert Bay was dominated by Bear River inflows during spring runoff (77%), but during summer, 60% of the load to Gilbert came from Farmington Bay. MODIS satellite imagery documented plumes of phytoplankton-rich water flowing out of Farmington Bay and overflowing into Gilbert Bay, particularly during summer. Isotopic analyses of ^{13}C and ^{15}N at 34 stations indicated, however, that the high algal production in Farmington Bay did not contribute substantially to the diets of brine shrimp in Gilbert Bay, at least during the May, June and November synoptic analyses. However, isotopic analyses suggested that brine shrimp utilize particulate matter exported from Farmington Bay (Naftz, D.L., C. Angeroth, T. Kenney, B. Waddell, S. Silva, N. Darnall, C. Perschon & J. Whitehead. 2008. Anthropogenic influences on the input and biogeochemical cycling of nutrients and mercury in Great Salt Lake, Utah, USA. Applied Geochemistry 23: 1731–1744).

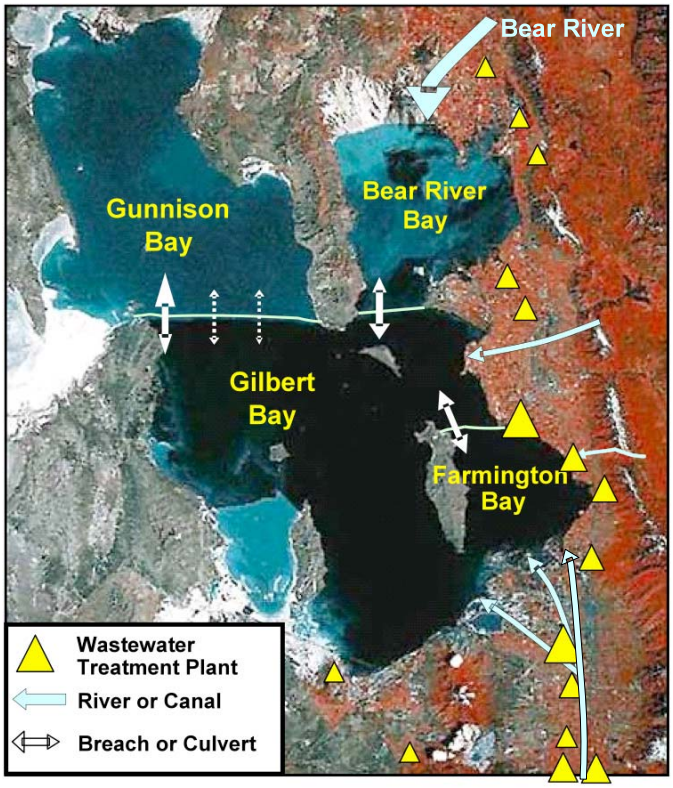

Figure 1–The four bays of Great Salt Lake showing causeways that separate the system into four bays. White arrows show flow paths between bays.

Particulate N export from Farmington Bay represented 11% of the primary production in Gilbert Bay from May to November. Preliminary estimates of nutrient loading to Gilbert Bay are > 2 g N m^{-2}, levels that can cause dangerous loading in freshwater lakes. Predicted population growth in the Great Salt Lake watershed is > 250% by 2050 and uncontrolled nutrient loading may consequently cause eutrophication problems not only in Farmington Bay, but in Gilbert Bay as well. The management of nutrient loading and other pollutants in Great Salt Lake will need to take into account these likely increases and the close coupling of the bays.